RECENT DEVELOPMENTS IN CONSTRUCTION OF RESIST TESTING TOOLS FOR THE NXE PLATFORM

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1. Introduction

Based on our experience with the first generation resist outgassing tool that has been fully operational for about 4 years with very good up time, we have developed and deleivered a next generation resist outgassing tool for measuring the contamination of optics from resist outgassing by using 13.5 nm EUV photon exposure, or alternatively by using e-beam exposure, of resist coated 300 mm wafers and witness samples.

Measurements are performed in an ultra-clean measuring chamber equipped with a high sensitive residual gas analyzer (RGA), so as not to add background (non-resist related) contamination, a separate electron gun illuminates the witness sample for cracking hydrocarbons during exposure and supplied with a LabView based extremely user-friendly and reliable control system.

This system can also be supplied initially with the e-beam exposure option and field upgrading to a photon exposure system by the addition of an Energetiq EQ-10 EUV source

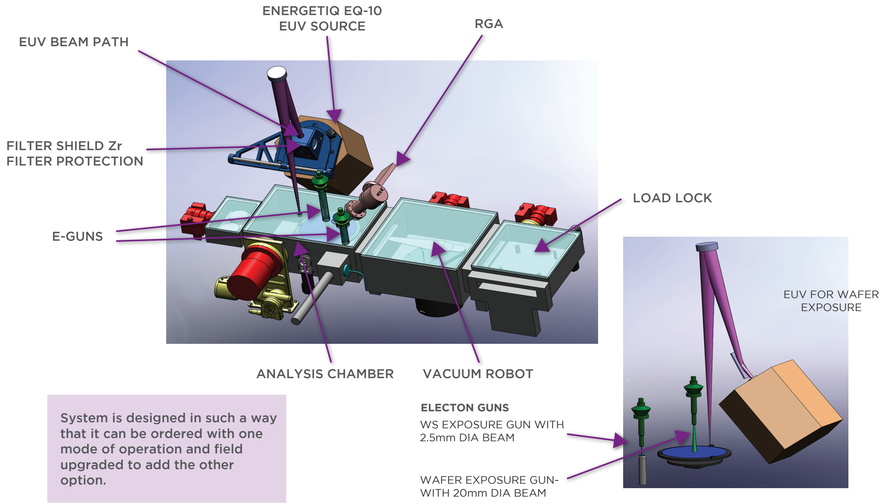
2. The salient features of the basic system the Model No. RER300-EX

- Kimball Physics EFG-7F/EGPS-2017 electron gun (wafer e-gun) capable of producing e-beam energies of 2000 eV to 5000 eV to expose resist-coated wafers, positioned to illuminate the resist-coated wafer at 90 degrees to the wafer surface and to illuminate approximately 10 mm diameter spot on the wafer.
- A separate Kimball Physics EFG-7F/ EGPS-1017 electron gun capable of producing an e-beam energies of 50 eV to 2000 eV to illuminate the witness sample at 90 degrees to its surface for cracking hydrocarbons during exposure to contamination with a spot size of 2 to 4 mm.
- All metal, low hydrocarbon, UHV measurement chamber that will accommodate a 200 mm or a 300 mm wafer and a lubricant free, in-vacuum R-theta scanning stage to translate the wafer and rotate it through 360 degrees to expose its entire surface.
- High sensitive UHV RGA detection system, 1-200 amu, minimum detectable partial pressure of 5 10-13 mbar and fast data acquisition rates to check the cleanliness of the measurement chamber and to quantify resist out-gassing products.
- Load lock equipped with a semi-automatic UHV Brooks vacuum robotic transfer system to transfer the 200mm or 300mm wafer to the main chamber and to unload it.
- Semi-automatic vacuum transfer system to transfer the witness sample to the main chamber and to unload it.
- User-friendly LabView based software to control the tool, for data analysis and to integrate dose snake analysis with an ellipsometer (not included).
- Ability to perform dose exposure to determine the dose-to-clear for the resist used.
- A calibrated leak valve and integrated heaters for baking the chamber.

3. The additional features of Model No. RER300-PEX

- A novel optical system to provide in-band spectrum of illumination of the resist-coated wafers by integrating the Energetiq EQ-10
- A filter shield to extend the lifetime of zirconium filters when photon excitation is used.
- Ability to perform true dose snakes using EUV radiation to determine the dose-to-clear for the resist used.
- Continuous monitoring of the source output EUV power using a high accuracy EUV detector when photon excitation is used.

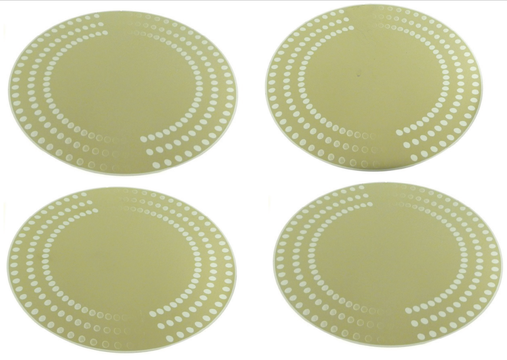
4. Outline of Resist Tool



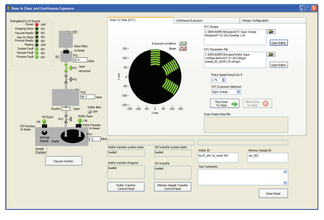
System is designed in such a way that it can be ordered with one mode of operation and field upgraded to add the other option.

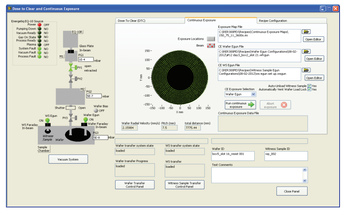
5. E-gun exposure results on our RER 300PEX

Repeatability of our E-gun exposure. Exposure six times on one wafer and repeated four days

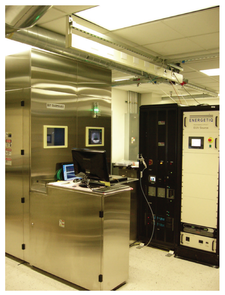


4. Control System





5. Resist Testing Tool



6. RGA testing of the Process chamber

Presssure in mbar

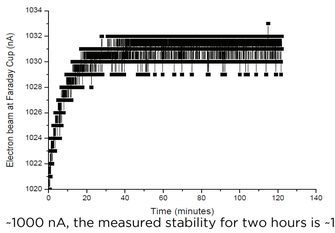
Component	ASML Requirement	Process chamber with stage idle	Process chamber when stage is moving, motors running	Process chamber during resist exposure (outgassing from the resist)	Process chamber after resist exposure (wafer removed from the chamber)	Process chamber after 2 hours of resist exposure (wafer removed from the chamber)
N2	<1.0E-7	4.90E-09	5.00E-09	6.30E-09	5.40E-09	4.90E-09
O2	<5.0E-8	2.80E-09	2.80E-09	3.30E-09	3.00E-09	2.80E-09
H2O	<1.0E-7	1.00E-08	1.00E-08	1.30E-08	1.00E-08	1.00E-08
Sum of amu 45-100	<1.0E-10	3.70E-11	4.20E-11	1.00E-09	4.18E-11	3.73E-11
Sum of amu 101-200	<5.0E-11	1.00E-13	5.90E-13	8.10E-12	1.00E-13	1.00E-13
Total pressure	<1.5E-7	3.60E-08	3.80E-08	4.10E-08	3.60E-08	3.60E-08

7. Continuous exposure at E0 by e-gun

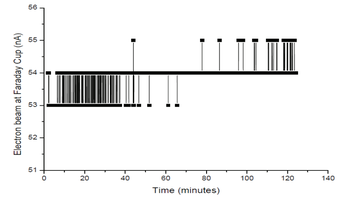
The exposed area is equivalent to 180% of a 200 mm wafer. (The requirement is 90% of a 200 mm wafer)

8. Wafer E-gun test requirement:

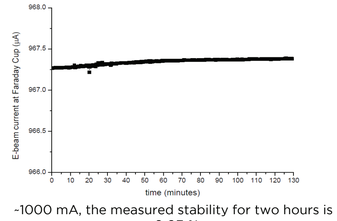
Measure the stability of electron beam for two hours (Specification< 5%)



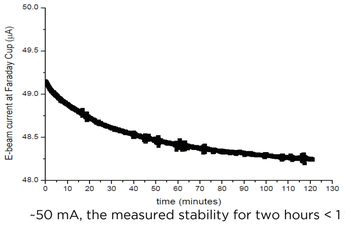
~1000 nA, the measured stability for two hours is ~1 %



~50 nA, the measured stability for two hours is < 2 %



~1000 mA, the measured stability for two hours is ~0.03 %



~50 mA, the measured stability for two hours < 1 %